CHROMOSOME COUNTS AND KARYOMORPHOLOGY OF SOME WEST TROPICAL AFRICAN SCILLEAE (LILIACEAE)

S. O. Oyewole[1]

Abstract

Karyomorphological analyses of Urginea ensifolia, U. pauciflora, Drimiopsis barteri, Dipcadi tacazzeanum, *and* D. longifolium *are presented. All the materials investigated were obtained from the wild in Nigeria. The karyotypes and chromosome counts are new records for the five species. Both* Urginea *species are* 2n = *20,* Drimiopsis barteri *is* 2n = *24,* Dipcadi tacazzeanum and D. longifolium *are* 2n = *12 and* 2n = *24, respectively. Other members of* Urginea *and all the known species of* Albuca, *which have previously been investigated and reported, are summarized.*

The tribe Scilleae Bak. (Liliaceae) consists of six genera in West Tropical Africa (*Albuca* L., *Dipcadi* Medic., *Drimia* Jacq., *Drimiopsis* Lindl., *Scilla* L., and *Urginea* Stein). The latest treatment of the Liliaceae in West Tropical Africa (Hepper, 1968) shows that these genera are represented by three (five, Gledhill & Oyewole, 1972), two, one, one, one, and four (six, Oyewole, 1975a) species, respectively. Most of the representatives of each genus show striking morphological similarities as well as population variations within each species, which make their taxonomic treatment difficult. There is evidence that many natural populations of the representatives of the tribe are not yet in herbarium collections, so it is likely that there are more taxa in the tribe than are now known.

In this paper, new reports on chromosome number and morphology are given for five representatives of the Scilleae.

Materials and Methods

Populations of each species were sampled during several field trips to different parts of Nigeria (Table 1). The species were identified using specimens at the Herbarium of the Federal Institute of Forest Research, Ibadan (FHI). Plants of each species were cultivated at the University of Ilorin, Nigeria. Voucher specimens are deposited at FHI, Ahmadu Bello University Herbarium (ABUH), and the Herbarium of the University of Ilorin (IUH).

Each plant was investigated separately, but plants of the same species were treated together. Cytological studies were carried out on squash preparations of young root tips following conventional methods as earlier reported (Oyewole, 1972). Chromosome index, *r* (ratio of long chromosome arm to the short arm), was determined according to Levan et al. (1964) as modified by Oyewole (1972), and the values were employed in analyzing the karyomorphology of each taxon.

Results and Discussion

Table 2 summarizes earlier work on the tribe Scilleae while Table 3 summarizes karyotype data on the new reports.

Urginea

The basic chromosome numbers of this genus are $x = 5$ and $x = 7$ (Darlington & Wylie, 1955; De Wet, 1957; Jones & Smith, 1967). The four species listed in the *Flora of West Tropical Africa* (Hepper, 1968) are

[1] *Department of Biological Sciences, University of Ilorin, P.M.B. 1515, Ilorin, Nigeria.*

Ann. Missouri Bot. Gard. 75: 196–202. 1988.

TABLE 1. *Sources of materials investigated (Scilleae).*

Taxa	Collection Site	Herbarium Voucher	Habitat
Urginea ensifolia	Fashola Rocks 12 km north of Oyo along Oyo–Iseyin Road	S00/0660, in ABUH, IUH, FHI	marshy foot of rocky hills in deciduous woodland
	also 6 km to Oshogbo along Oshogbo–Gbongan Road	S00/0752 in ABUH, IUH, FHI	in marshy roadside, deciduous woodland
Urginea pauciflora	Chanchagwa Hills, Minna	S00/0764 in ABUH, IUH, FHI	in gravelly soil on hillcrest on the outskirt of Minna, in low grassland savanna
Dipcadi tacazzeanum	Igbetti about 150 km north Oyo	S00/1001 in IUH, FHI	in dark, humus soil in shaded deciduous woodland
	12 km north of Ilorin along Lagos–Kaduna Road	S00/1091, S00/1092 in IUH, FHI	in dark, humus soil in open shallow soil on rock outcrops in grassland savanna
	Shao, 22 km northwest of Ilorin		
Dipcadi longifolium	Babanloma, about 72 km north of Ilorin along Lagos–Kaduna Road	S00/1008, in IUH, FHI	in dark, humus soil in rock inselbergs; deciduous woodland
	about 20 km to Kabba along Kabba–Okene Road	S00/1104–1110, in IUH	in dark gravelly soil at foot of rock hills; deciduous woodland
	Nasarawa Village along Mokwa–New Bussa Road	S00/2174, in IUH	in dark brown, clay–loamy soil; open, seasonally marshy grazing land
Drimiopsis barteri	Tegina, a small junction village along Lagos–Kaduna Road, about 144 km to Kaduna	JMC/79, in IUH	in open, seasonally marshy rock soil in grassland savanna
	Kaduna Airport environment	S00/1221, in IUH	gravelly brown soil on rock outcrops in grassland savanna

FHI—Herbarium of the Federal Institute of Forest Research, Ibandan.
ABUH—Ahmadu Bello University Herbarium (Department of Biological Sciences, Ahmadu Bello University, Zaria, Nigeria).
IUH—University of Ilorin Herbarium (in Department of Biological Sciences).

TABLE 2. *Previous chromosome counts in Scilleae.*

Taxa	Somatic Number	Haploid Karyotype[1]	
1. *Albuca* L. $x = 9$ (Oyewole, 1972)			
A. abyssinica Murray	18	3 L	6 S
A. fibrotunicata D. Gledhill & S. O. Oyewole	36	6 L	12 S
A. scabromarginata De Wild.	36	6 L	12 S
A. sudanica A. Chev.	36	6 L	12 S
A. nigritana (Baker) Troupin			
cytotype I	54	9 L	18 S
cytotype II	54	12 L	15 S
2. *Urginea* Stein $x = 5$ (Oyewole, 1975b, 1987a, c)			
U. altissima Baker sensu stricto ($2n$ = 20 + 2ff)	22	4 L	7 S
U. gigantea (Jacq.) Oyewole	22	4 L	7 S
U. viridula Baker	20	4 L	6 S
U. indica (Roxb.) Kunth	20	Variable	

[1] L = long chromosome (> 4.5 μm in length); S = short chromosome (< 4.5 μm in length).

TABLE 3. *Summary of karyotype data (Scilleae) (chromosome length in μm).*

Taxa	Homologues 1	2	3	4	5
Urginea ensifolia					
Chromosome length	7.0	6.88	6.8	6.0	5.63
r-value	6.0	16.0	23.0	5.6	36.0
Centromeric location	subterminal	terminal	terminal	subterminal	terminal
Urginea pauciflora					
Chromosome length	9.13	8.13	5.31	3.94	3.75
r-value	8.6	15.25	4.5	2.94	6.5
Centromeric location	terminal	terminal	subterminal	submedian	subterminal
Dipcadi tacazzeanum					
Chromosome length	7.3	6.3	5.1	3.5	2.6
r-value	13.6	11.6	9.2	6.0	3.0
Centromeric location	terminal	terminal	terminal	subterminal	submedian
Dipcadi longifolium					
Chromosome length	8.88	8.13	7.13	6.38	6.0
r-value	10.85	20.4	13.26	24.52	11.0
Centromeric location	terminal	terminal	terminal	terminal	terminal
Drimiopsis barteri					
Chromosome length	9.13	9.13	7.88	6.75	6.25
r-value	5.62	7.11	3.5	2.38	2.33
Centromeric location	subterminal	terminal	subterminal	submedian	submedian

U. altissima Baker, *U. indica* (R. & B.) Kunth, *U. ensifolia* (Thonn.) Hepper, and *U. pauciflora* Baker. More recent work, however, has shown that *U. altissima* is a complex of three distinct species (Oyewole, 1975a), all of which have been investigated karyotypically (see Table 2). *Urginea indica* has been treated separately on account of its variable nature (Oyewole, 1987b, c) and is included in Table 2.

Urginea ensifolia has a somatic complement of 20 chromosomes. The karyotype is represented by twelve long and eight short chromosomes (Figs. 1A, 2A). Chromosome lengths vary between 1.0 μm and 7.0 μm. The six long pairs have terminal to subterminal centromeres. The first two short pairs have submedian to median centromeres, while the last two pairs are dotlike and without observable second arms: they are telocentric. The third long pair has an inconspicuous second arm and a secondary constriction on the long arm.

Urginea pauciflora also has a somatic complement of 20 chromosomes. The karyotype is represented by three long and seven short pairs. The chromosome lengths vary from 2.5 μm to 9.13 μm. All the long chromosomes have subterminal to terminal centromeres. Three short pairs have subterminal to terminal centromeres; three others have submedian to median centromeres, while the seventh pair has a very inconspicuous second arm (Figs. 1B, 2B).

All *Urginea* species so far investigated have $2n = 20$ except *U. volubilis*, a Madagascan species ($2n = 14$, Jones & Smith, 1967). With a basic number of $x = 5$ or $x = 7$, the West African species of *Urginea* are polyploids. However, from karyotype studies, these species have somatic complements that are resolvable into homologous pairs. *Urginea altissima* sensu stricto, with $2n = 20 + 2ff$, has been shown to have normal meiosis with ten bivalents (Oyewole, 1987a). The basic number of $x = 5$ therefore applies to the West African *Urginea* species which are thus tetraploids.

TABLE 3. *Continued.*

Homologues						
6	7	8	9	10	11	12
5.0 19.0 terminal	3.0 2.0 submedian	2.0 1.0 metacentric	1.5 0 telocentric	1.0 0 telocentric		
3.50 1.33 median	3.13 24.0 terminal	3.0 0 telocentric	3.0 2.0 submedian	2.5 9.0 terminal		
2.2 3.4 subterminal						
5.75 10.5 terminal	5.0 15.0 terminal	4.88 9.52 terminal	3.0 59.0 terminal	2.75 2.0 submedian	2.75 10.0 terminal	2.25 0 telocentric
6.25 2.90 submedian	5.38 1.86 submedian	4.75 2.17 submedian	4.31 1.16 median	4.0 4.0 subterminal	3.75 1.50 median	3.75 1.14 median

DIPCADI

Two basic numbers, $x = 4$ and $x = 9$, are already reported for this genus (Darlington & Wylie, 1955); Hepper (1968) recognized two species, *D. longifolium* Lindl. and *D. tacazzeanum* (Hochst. ex A. Chev.) Baker, into which he merged Morton's (1961) *D. filamentosa* Medic. as a morphological variant. Several natural populations of individuals identifiable as *D. filamentosa* have recently been encountered during field trips in Nigeria, and the cytogenetic relationship of this group with the other species of the genus is still being investigated at Ilorin, Nigeria.

Dipcadi tacazzeanum (excluding all materials identifiable as *D. filamentosa*) has a somatic chromosome complement of $2n = 12$. Chromosome lengths range between 2.2 μm and 7.3 μm, and the karyotype consists of three long and three short pairs. The fifth pair has a submedian centromere, while all the others have terminal to subterminal centromeres (Figs. 1C, 2C). The third pair has a secondary constriction in the long arm.

Dipcadi longifolium has a somatic complement of $2n = 24$. The complement consists of 16 long and eight short chromosomes, with chromosome lengths ranging from 2.2 μm to 8.9 μm. One pair of short chromosomes is telocentric, another has submedian centromere, while the remaining two short and all the eight long pairs have terminal to subterminal centromeres (Figs. 1D, 2D). One of the short pairs with the centromere in the terminal region varies morphologically in different individuals—one or both members have an extended centromeric region. Four pairs (1st, 3rd, 4th, and 6th) have a secondary constriction each in the long arm. With a somatic complement of 24 chromosomes, this species is a polyploid.

Jones & Smith (1967) reported a somatic chromosome number of $2n = 12$ for a diploid species suspected to be *D. gracillium.* The records of $2n = 8$, 18, and 34 for three different species, by which the basic numbers of $x = 4$, 9 were determined, were from southern African materials (see Darlington &

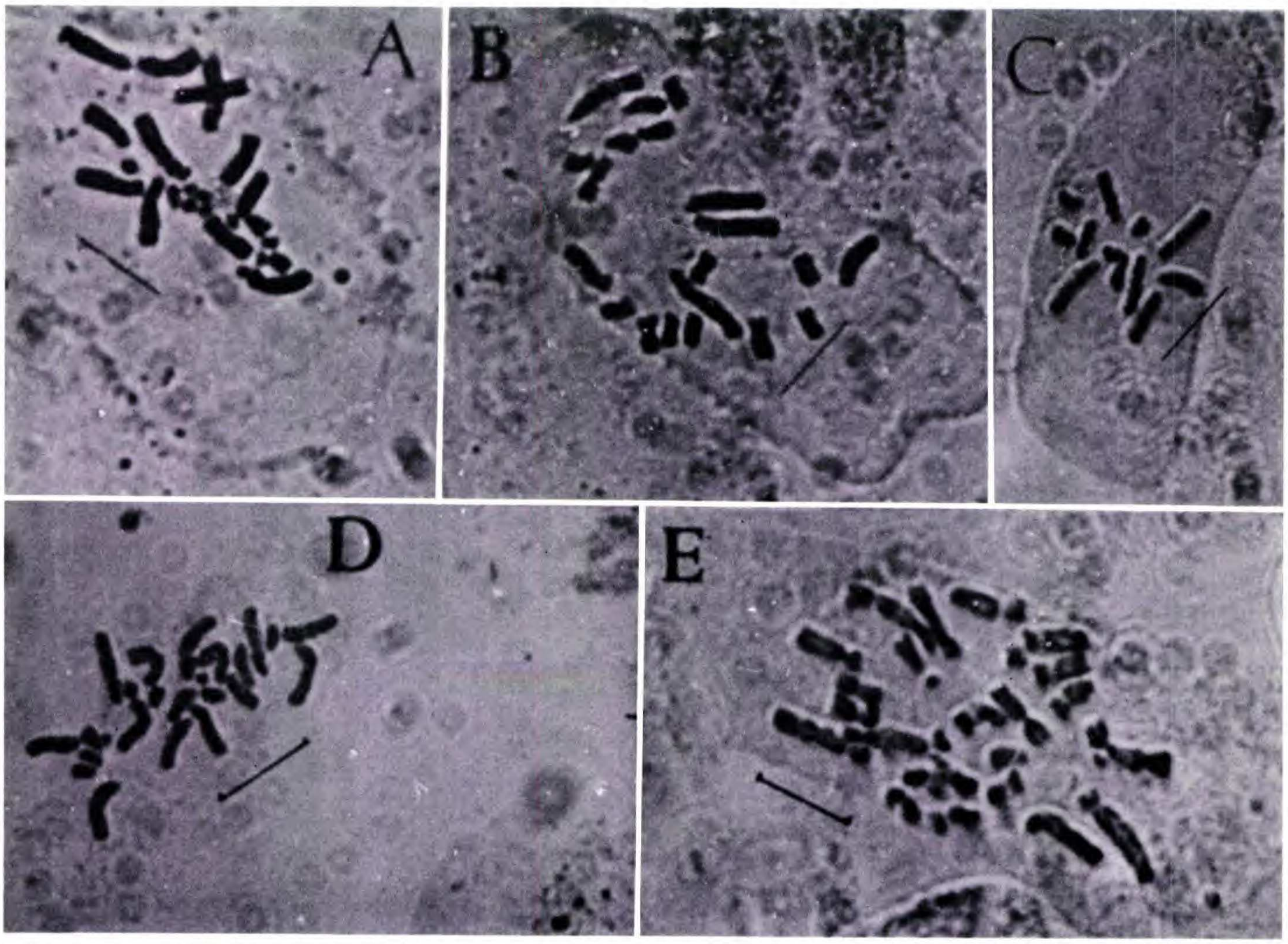

FIGURE 1. *Somatic metaphase complements.* —*A*. Urginea ensifolia.—*B*. Urginea pauciflora.—*C*. Dipcadi tacazzeanum.—*D*. Dipcadi longifolium.—*E*. Drimiopsis barteri.

Wylie, 1955). The two somatic numbers reported here show two ploidy levels and favor a new basic number of $x = 6$, which is supported by chromosome morphology. Thus, one of the two species is a diploid, $2n = 12$ (*D. tacazzeanum*) and the other a tetraploid, $2n = 24$ (*D. longifolium*).

DRIMIOPSIS

This genus is represented by *D. barteri* Baker, as Hepper (1968) recorded. This species has a somatic number of $2n = 24$. The chromosomes fall into twelve morphological pairs, with members of the pairs generally unequal. Chromosome lengths vary between 3.0 μm and 10.0 μm. The complement does not show bimodal categorization into long and short chromosomes. However, seven pairs are longer than 5.0 μm while the other five are shorter than 5.0 μm. Four pairs (1st, 2nd, 3rd, and 10th) have terminal to subterminal centromeres, while the others have submedian to median centromeres (Figs. 1E, 2E). Plants of this species are known to be sexually sterile; meiotic behavior and cause of sexual sterility have been reported (Oyewole, 1984a, b).

Darlington & Wylie (1955) reported a basic chromosome number of $x = 8$ for the genus from South African materials. A somatic chromosome count of $2n = 24$ indicates triploidy. However, Oyewole (1984a, b) showed that a basic number of $x = 6$ rather than $x = 8$ is more consistent with the somatic complement of the West African species of *Drimiopsis*. Two wild and morphologically distinct populations recently sampled in Nigeria have a somatic complement of $2n = 24$ each, as in *D. barteri*, and are sexually reproductive. Their cytogenetic relationship with *D. barteri* and with each other, as well as their taxonomic positions, are being investigated at Ilorin, Nigeria.

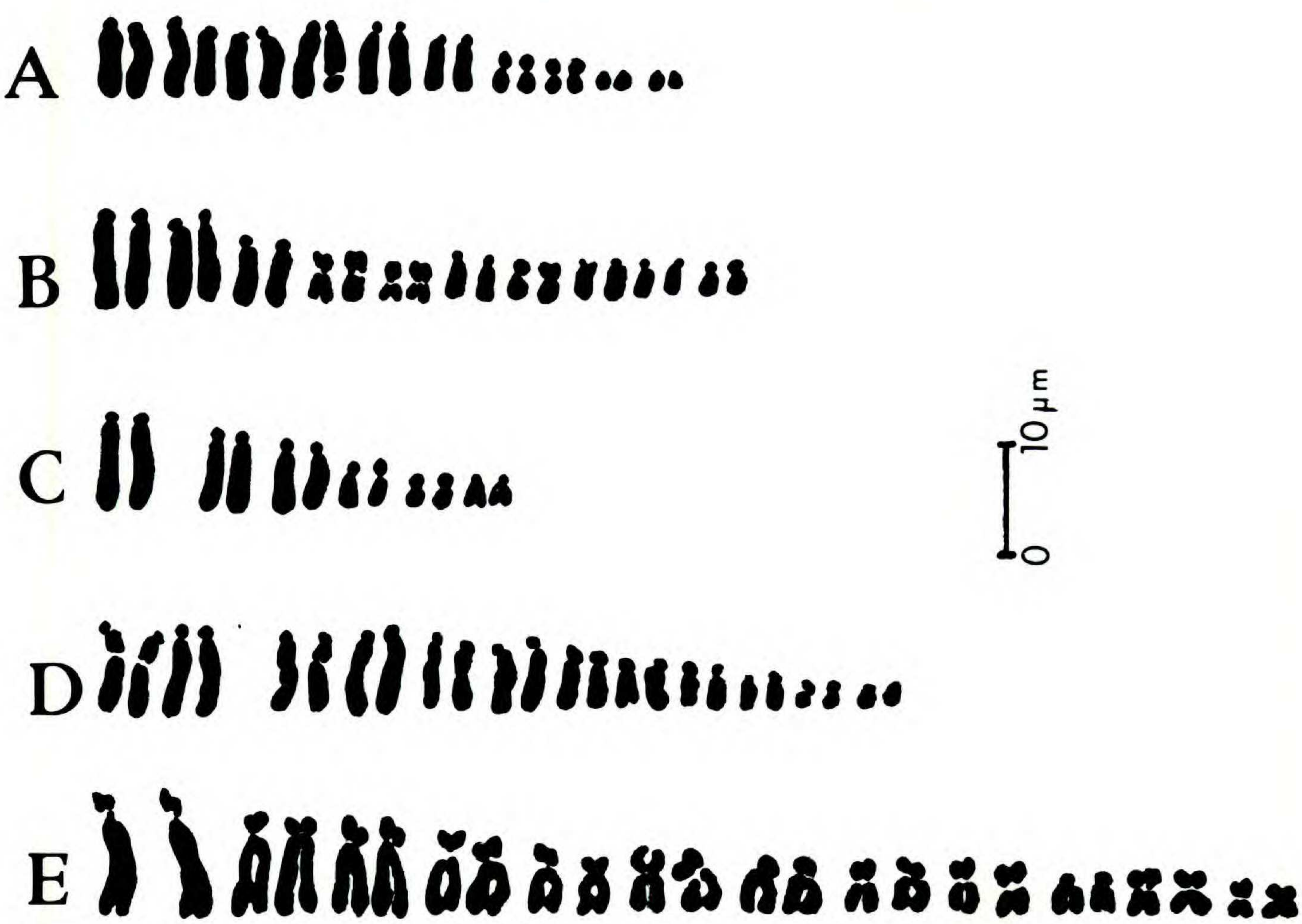

FIGURE 2. *Drawings of the somatic karyotypes.—A.* Urginea ensifolia.—*B.* Urginea pauciflora.—*C.* Dipcadi tacazzeanum.—*D.* Dipcadi longifolium.—*E.* Drimiopsis barteri.

Chromosome length bimodality in certain members of the tribe Scilleae has been reported (Jones & Smith, 1967; Oyewole, 1972, 1975b). This has held true in the present work for the two species of *Urginea* and the diploid *D. tacazzeanum* but not with *D. longifolium* and *D. barteri.* Also, while the West African members of *Albuca, Urginea,* and *Dipcadi* can be said to have a preponderance of chromosomes with terminal to subterminal centromeres, *Drimiopsis* contains a higher number of submetacentrics. It is not possible, therefore, to formulate a common pattern of karyotype evolution in the tribe from mere chromosome morphology.

The morphological similarity among the different genera in this tribe is not correlated with similarity in karyotype morphology. If the morphological similarity is a result of common ancestry for the members of the tribe Scilleae, then karyotypes have evolved along various lines.

Alternatively, morphological similarity in the tribe may be a result of convergent evolution, in which case the tribe would be polyphyletic.

LITERATURE CITED

DARLINGTON, C. D. & A. P. WYLIE. 1955. Chromosome Atlas of Flowering Plants. George Allen & Unwin, London.

DE WET, J. M. J. 1957. Chromosome numbers in the Scilleae. Cytologia 22: 145–159.

GLEDHILL, D. & S. O. OYEWOLE. 1972. The taxonomy of *Albuca* in West Africa. Bol. Soc. Brot., Ser. 2, 46: 93–106.

HEPPER, F. N. 1968. Liliaceae. *In:* Flora of West Tropical Africa 3(1): 104–110.

JONES, K. & J. B. SMITH. 1967. The chromosomes of the Liliaceae. I—The karyotypes of twenty-five tropical species. Kew Bull. 21: 31–38.

LEVAN, A., K. FREDGAR & A. A. SANDBERG. 1964. Nomenclature for the centromeric position on chromosomes. Hereditas 52: 201–220.

MORTON, J. K. 1961. West African lilies and orchids. Pp. 8–9 *in* A West African Nature Handbook. Longmans, London.

OYEWOLE, S. O. 1972. Cytological and cytogenetic studies in the genus *Albuca* L. in West Africa. Bol. Soc. Brot., Ser. 2, 46: 149–170.

———. 1975a. Taxonomic treatment of the genus

Urginea altissima (L.) Baker complex in West Africa. Bol. Soc. Brot., Ser. 2, 46: 163–172.

———. 1975b. Cytotaxonomic studies in the genus *Urginea* Stein in West Africa. I: karyotype analysis in *U. altissima* Baker, *U. gigantea* (Jacq.) Oyewole, and *U. viridula* Bak. (emend.). Bol. Soc. Brot., Ser. 2, 46: 213–223.

———. 1984a. Pachytene analyses and karyotype of *Drimiopsis barteri*. Cytologia 49: 81–86.

———. 1984b. Microsporogenesis and sexual sterility in *Drimiopsis barteri*. Cytologia 49: 87–93.

———. 1987a. Cytotaxonomic studies in the genus *Urginea* Stein in West Africa. II: karyotype evolution in *Urginea altissima* (L.) Baker. Annals Missouri Bot. Gard. 74: 126–130.

———. 1987b. Cytotaxonomic studies in the genus *Urginea* Stein in West Africa. III: the case of *Urginea indica* (Roxb.) Kunth in Nigeria. Annals Missouri Bot. Gard. 74: 131–136.

———. 1987c. Cytotaxonomic studies in the genus *Urginea* Stein in West Africa. IV: population differentiation and karyotype variation in *Urginea indica* (Roxb.) Kunth. Annals Missouri Bot. Gard. 74: 137–143.